PETER HESSELDAHL
GROUND RULES FOR THE 21ST CENTURY
Chapter 15

RIDE THE UNDERCURRENT OF TECHNOLOGY

There is no other species than humans, which really uses technology, let alone which, like us, can change both ourselves and the world around us by constantly developing new tools. We define our stages of development by the technology we had available: We have had Stone Age, Bronze Age, Iron Age - and the question is what one should call the period we are living through now?
During industrialization we overcame distances and we learned to harness immense physical powers. Today, our development is characterized by the advances in information technology. Our rapidly increasing ability to handle huge volumes of data and share them instantly through the global network clearly change who we are and what we are capable of as a species. The developments in IT are like a deep and strong undercurrent, which pushes us forward and pulls the next wave of technologies, like biotechnology and nano-tech, along.
One cannot discuss the strategies for the future without taking into account how information technology will change conditions. IT has been defining the world in the last 30 years, its significance has grown steadily, and indications are that the changes it brings will accelerate even further in the coming decades. *You ain't seen nothing yet.*

Years ago, Bill Gates observed that if one were to imagine the business opportunities of the future, you should do so from the expectation that the price of computing power will go towards zero. As Gates saw it, the applications, which have time on their side, will be those that will emerge as you can start spending previously unimaginable amounts of computing power to run them.
It's still a good advice. The price of computing power has continued to fall steadily, computers are getting cheaper, lighter, smaller, and more powerful - and as they do, entirely new areas and ways in which to use computer power open up.
But beyond the falling price of hardware, the IT development can be characterized by a number of other key trends for the nature of our use of information. Essentially there are seven trends.

Our information about the world is steadily going in the direction of being:
1. In microscopic detail
2. Realtime
3. Globally connected
4. Positioned
5. Stored
6. Searchable
7. And finally, the physical and the virtual realms will increasingly merge.

The list are some rules of thumb - an indication of the technological circumstances and opportunities, we can count on and plan to exploit in the future. With a term from mathematics, the trends can be thought of as *vectors*; an indication of the direction and the strength of a movement. It's these kinds of long-term and robust trends that those of us who make our living trying to gauge the future, cling to. The idea here is that - regardless of industry – one can try to extrapolate the trends a bit into the extreme, and imagine how they might affect what is possible in a few years.

We will go through the list from an end in this chapter. It will not be a detailed description of what new gadgets to expect. Instead, the goal is to take a step back and look at the bigger picture in order to understand which way the technological undercurrent pulls us.

1. Microscopic detail

The word "resolution" is used to describe the level of detail in recordings such a photo or an audio file. Generally speaking, the resolution of the information we have available is increasing in all areas that are affected by the development of digital technology.

In the field of photos and video, both ”real” cameras and the tiny cameras in mobile phones get more and more megapixels of resolution. In video, the old TV standard is being replaced by HDTV and 3D-TV, which have several times as many pixels per frame. And every year the computer graphics in games and Hollywood movies are becoming increasingly detailed and realistic.

Our information is also getting more detailed in the sense that there will be ever-shorter distances between measurement points. There will be many more devices around us with their senses *on*. In the chapter on responsibility and accountability, we discussed how the digitization of virtually all functions of society imply that a rapidly growing part of everything that we and others do leaves digital traces: our queries and communications online, our use of credit cards, our location (through cell phones and GPS devices) and our behavior in public places, recorded by an increasingly dense cover of surveillance cameras and cameras in traffic. More and more aspects of everyday life will be captured.

Sensors are spreading rapidly, and it seems almost inevitable that we will see a very strong growth in the number and density of sensors in our environment. We already have plenty of them installed: smoke detectors, motion sensors to turn on lights and activate alarm systems, thermostats to regulate temperature, proximity sensors on cars to help parking, heart rate monitors and pedometers for training, etc.
Sensors are typically very simple devices and in many cases, they will eventually be manufactured in the micrometer or even nanometer scale. It will be cheap to equip objects and environments with a myriad of sensors that can deliver a continuous and extremely accurate monitoring of humidity, acceleration, light, chemicals in the air and water and so on. Other foreseeable applications are sensors in packaging that can detect whether food is still fresh, or sensors, which are implanted in the body or even floating around in the blood vessels to monitor whether we are in proper chemical balance.
Overall, our surroundings will gradually become equipped with a highly sensitive and dense sensory system whose data will be available for our machines and us. Together, the sensors and the many other appliances that have built-in computer power, will provide an extremely detailed understanding of our surroundings and make it possible to control them with much greater precision - whether it is indoor air in a building, the flow of goods through the supermarket, monitoring of environmental conditions or

traffic management.

Exact personalization

The trend towards higher resolution closely matches the trend towards individualization of products and services. As consumers, each of us will increasingly expect to have things exactly as we want them.
It is a prerequisite in order to target and customize services to the individual client's situation that we have detailed information available. We *will* have data, in abundance, and therefore it becomes an essential skill for businesses to understand how to transform the deluge of information about everything and everyone into meaningful improvements for the individual customer in an ever more specific context.

The greater precision and ever finer detail is echoed in the physical makeup of our products. In many contexts it is certainly no longer an advantage that an item is "handmade" because a large part of the goods we consume, can only be made with sufficient precision by robots.
With each new generation of electronics, we manage to cram more features into less space. The ultimate in this direction is *nanotechnology*. One of the definitions of nanotech is that it works with elements that are smaller than 100 nanometers – roughly, about one thousandth the thickness of a plain sheet of printer paper. As of this writing, Intel sells computer chips, on which the width of the electronic circuits in the silicon is 32 nanometers.
One of main tools when working at nano-scale is an STM: Scanning Tunneling Microscope, which can detect the appearance of a surface by running an extremely fine tip over it - almost like a pickup in the grooves of an old LP-record, but at a *much* smaller scale. With an STM, you not only can see individual atoms; an STM can also be used to rearrange the atoms, one by one.

Looking at the so-called *3D printers* offers a clue about how the trend towards greater detail will affect our physical products.
As we touched on in Chapter 6 - *From product to process* - 3D printers build up spatial objects with a technology that is similar to an inkjet printer, by placing tiny dots of ink on paper with high precision. A 3D printer doesn't use ink but a resin of a type of plastic that can be hardened. By adding layer upon layer upon layer of dots the printer converts a three-dimensional design in a computer into a physical object.
3D printing is very different from conventional manufacturing. For example, it doesn't cost more to produce an object in a very complex design with lots of small details. In traditional manufacturing, it requires extra work and more processes to create more intricate objects. But a 3D printer doesn't care what it produces. It follows the instructions of the computer, moving along and leaving dots or gaps, one at the time, exactly as it is told to do. If an object is complex or simple doesn't affect the speed of the printer. What determines cost is the amount of material used – the number of dots that are applied. This has the paradoxical consequence that the simplest object is actually the most expensive to print out. A massive block requires lots of "ink", whereas a design with lots of filigree and tiny details does not consume as much material.
As Neil Gershenfeld of MIT's "Fab Lab", puts it, you get "complexity for free" with 3D printers. His conclusion is that 3D printing will give us the same precision and control of atoms - the physical realm - which we currently have over bits when

working with drawings and photos on a computer screen.

A peek into the inner workings of biology

Our increasing insight into the very smallest parts is repeated in the field of biology. Advances in medicine and biotechnology are essentially based on an understanding of biology in ever-finer detail.
Once, the invention of the stethoscope gave a unique new insight into the body. Today, we can look all the way into the way our brain thinks and feels. So-called *Functional MRI scanners* can show where in the brain blood flow increases as different parts of the brain are engaged in various types of mental activity. Thus, doctors, psychologists - even police and marketing researchers - have a promising tool to understand how different kinds of thoughts are formed.

Our understanding of genes is getting more and more detailed as well. The cost of decoding DNA sequences is falling even faster than the price of computer chips, and at the same time we are developing powerful tools to analyze the vast quantities of data, so they are usable in our daily efforts to stay healthy.
Looking slightly ahead, we are very likely to see medications, dietary supplements or foods that are tailored to individual persons based on an analysis of his or her genes. Farther out into the speculative is the idea of "designer babies" whose parents tweak the properties of their future dream child by adding extra features or removing features they do not want the child to inherit. In principle, it’s comparable to configuring a car or a kitchen by picking the modules you like best.

The increasing resolution is evident in the data we collect, in our control over our physical environment and products, and in our understanding of biology. In all fields, we understand things with ever-greater precision. Our detailed knowledge will make it possible to intervene with increasing precision in areas that were previously out of reach to us – and it will form the basis for a wide range of brand new products and services specifically tailored to the context in which they are used.

2. Realtime: Seeing it as it happens

Information is getting fresher. We collect them at shorter intervals, and we can access them ever faster.
The logical continuation of this trend is that delays eventually disappear completely, so we can all see the information we need, in real time - as it happens.

I greatly appreciate the online weather forecasts, and to me a large part of their utility is the fact that they are updated very often and that they are subdivided in great detail with local views for even smaller towns. If I am considering whether I can take a quick jog in the woods between two rain showers, I will obviously not look at the forecast in the newspaper, which was printed sometime last night. I will go online to see the latest animated radar images, so I can follow the pattern of cloud movements up to half an hour ago. Looking a few years further ahead, it would be very strange, if the online weather reports were not of an even higher resolution and frequency – just like the navigation systems in the car and on the phone are likely to be almost constantly updated with reports of traffic jams, road works and delays on trains and buses.

Today, two to three years may pass before Google Earth updates the satellite images of an area. When the old images are updated, invariably the photos will be amazingly sharper. And again, it would be very surprising if satellites in the future didn't take pictures at shorter intervals and in even better resolution.
It's a general trend: In businesses, it will be measured more accurately what was sold in each store, and the entire supply chain behind the products will instantly get feedback on what sells and where. Control of traffic with traffic lights and variable traffic signs will be based on more precise knowledge about the situation on the roads, *here and now*. Patients will have their medication released in a small, steady stream in the body from small pumps that are operating based on ongoing measurements of what the body needs.

Today we are so accustomed to the digitization of all of our administrative systems that we are surprised, when we come across situations where information is *not* registered or updated. Looking back, just 25-30 years ago, the recording and handling of information was extremely labor intensive. Barcodes were introduced on groceries in the late eighties, and until then, stores had a much harder time tracking what products were purchased. About the same time as barcodes were rolled out, banks began to gain insights into where we spent our money, as people began to pay by credit card rather than cash.
In retrospect, it seems as though we were acting blindly in the past - not so terribly long ago. In 25 years' time you will probably look back and shake your head in disbelief over how imprecise, sporadic and limited the information that we - and our machines – were acting on, was today.

If we return to the concepts of complexity theory for a moment, then the tendency for our data to be in realtime, could be described as *reducing the lag time in the feedback*. There is less delay between an action and the reaction to it, and this makes connections between events more direct and precise.

<u>3. Globally connected: Everything and everyone is linked</u>

It has been a fundamental trend since the beginning of time that everyone and everything is connecting. We're linking up: People with people, people with machines and machines with machines.

Year by year we find that computer chips are built in to more and new types of objects. House keys, bath scales, musical instruments, electric sockets ... you name it. It is reminiscent of the way we started electrifying all our everyday appliances. Having an embedded computer chip makes it possible to run a program - a toothbrush, for example, can go through a series of different brush movements, and make a sound, when you have brushed for a few minutes.
Looking ahead, however, the crucial difference between an object *with* a chip and an object *without* is that an object with a chip can be connected to other items with chips in them - in principle to the entire network of all chips in the world. They can exchange information, draw on each other's observations, coordinate their actions and be remotely controlled from anywhere in the network.

Interconnection challenges our traditional idea of what it means for something to be local. Once the functionality of the objects, that serve us, depends on a digital force that resides *out there somewhere*, and when what we do in one particular place, increasingly interacts throughout the rest of the system, the concept of "local" becomes pretty loose.

This is one of the aspects of the trend towards *cloud computing*, where data, applications and computing power is delivered from large data centers, somewhere out there on the net. The idea of cloud computing is that each local device does not need much computing power or memory, because if only its chip is connected to the network, it can draw on all the power and information that is available "in the cloud". It’s analogous to our use of electricity. We don’t have to each produce our own electricity to power our appliances; we leave it to the large, central power stations operated by the utilities, which ensure that there is always plenty of power for us to draw on.
Google, Amazon and Microsoft are among the companies that operate massive "server farms"; halls the size of football fields, with row after row of servers, and the power consumption equivalent to a large Danish provincial town.

In the cloud-computing model, even the smallest gizmo can draw on huge amounts of data and extensive calculations, if only it can send data back and forth. A future thermostat in your living room will not be equipped with a supercomputer, yet it may be extremely intelligent and draw upon an enormous amount of data as the basis for the way it operates.
A large part of the value of a future thermostat lies in the fact that it is connected to the rest of the network - and exactly the same will apply to all sorts of other objects; whether it’s cars, cell phones, home appliances, shoes or furniture.

<u>RFID chips bridge between physical and virtual objects</u>
Barcodes were a big step towards linking physical objects with the digital systems that are used to keep track of them. The successor to the barcode will probably be the so-called *RFID tags* - small, extremely cheap and simple computer chips. Like the barcode, RFID tags should be used to identify an object and, like bar codes, RFID tags should be so simple and inexpensive that practically any object can be fitted with a small chip. The system consists of two parts: the small tags which can be attached on a myriad of goods and objects - and a reader that can detect the tags that are located nearby.
RFID stands for Radio Frequency Identification. In principle, a tag just consists of a small processor and an antenna. It has no power supply; instead the chip gets activated when its antenna is struck by radio waves from an RFID reader. The energy of the radio waves generates enough power that the chip can send a small squeak of data back to the reader: it simply announces its identity.

We know the system from paying at toll roads in many countries. When you drive through the toll station, the chip placed in the driver’s windshield is hit by beams from the reader at the barrier, the chip transmits its ID number, and the system can then look up the owner and charge his account.
The same system is widely used at ski resorts, and it is used for payment in the underground train systems of several large cities - including in London, Tokyo and Moscow. Some countries, including USA, UK and Japan are now issuing passports with embedded RFID tag, and the technology has found its way to the marking of library books and medical records. Livestock and pets are routinely tagged by

inserting a small chip the size of a grain of rice under the skin. Needless to say, there are also a few examples of people who have had an ID tag implanted.

With RFID tags, the global ecosystem of connected computers over the coming decades will be populated with many billions of small processors. The little chips will, so to speak, be at the bottom of the food chain of information devices - a kind of electronic plankton.

To understand the potential of the small chips, one should imagine that they will eventually be imbedded in *all* the goods we buy. For producers and retailers, this will initially make inventory management faster and easier because, unlike with bar codes, you do not need to scan each object. An RFID reader can automatically keep track of which items are within reach of its signal. In the shop, it will no longer be necessary to have goods scanned at checkout. You will be able to package your groceries directly from the shelf and just drive the cart with your bags past an RFID reader at the exit.

In the consumer's home the tag reader in the refrigerator will make the fridge understand which foods are stored in it. The washing machine's reader can detect whether a black sock had been mixed with the white shirts. The cleaning robot knows what it is picking up, so it can put it in the right place. And when we eventually throw an object in the trash and it lands on a conveyor belt at a recycling center, the robots there can use the chip to know which materials it is made of and whether there any special recycle procedures associated with the product.

The functionality of an object with an embedded chip - a shirt, a banknote, a tube of toothpaste - is fundamentally different from that of an object without a chip. Not because the chip itself is capable of much, but because the chip connects the object to the network.

In practice this means that the physical object will be a link to online information - just like a link on a web page. When you query it, you get access to information related to the object.

Suppose, for example, you have an RFID reader built into your cell phone and you use it to scan a product in a store, then the phone could either look up that product's own website, or the phone could search all the information available on the Internet about the item. Thus, the usefulness of a product equipped with a chip depends very much on what information and services are associated with the product online. It is increasingly the connection to the rest of the network that makes the object what it is.

<u>4. I'm right here: data sorted by location</u>

Just like the clock made it possible to structure information chronologically, then location technologies will mean that a lot of our information will be arranged according to which location or what specific object the information is associated with.

One of the most important technological developments currently is the proliferation of GPS and other location technologies. Like the watch, positioning technologies will virtually always be available to us and to our devices. Knowledge about position will be the key to new layers of experience and knowledge that can enrich the physical reality we are moving around in.

- Millions of cars have GPS navigation and access to knowledge about current traffic conditions, tourist attractions and practical information. Navigation system also make it possible for others - for example, those who manage a company's fleet of vehicles - to see where the car is or to track the car in case of accident or theft.
- Very soon it will become normal that a camera knows where it is, so it can tag all photos with geo-data, in order for images to be sorted by where they were recorded.
- And of course our own position will be determined and tracked. Using our mobile phone we will always have the locally relevant information available, and our position will be visible to those we choose to share that information with. Facebook, Twitter, Foursquare and a plethora of other new geo-location services are scrambling to develop ingenious ways to analyze and make use of the fact that users' postings and sensor data are labeled with their position.

The emergence of positioning technology is interacting with the other trends for IT, for example, the trend towards increased resolution. The GPS system was originally designed for military purposes and when signals from the satellites were made available to civilians, a limit to the accuracy was deliberately incorporated in the system from the U.S. military's side. Back then, in the mid-nineties, the precision of navigational systems, therefore, were within 100 meters. At this writing, a typical GPS unit, such as those you use in cars, have a precision of five to ten feet, but by combining satellite navigation with other types of positioning or by using improved methods of computing, it’s possible to achieve resolutions of less than ten centimeters.
That’s a quantum leap: from 100 meters to 10 centimeters in 15 years, and the accuracy will inevitably get better in the coming years - simply because there is fierce demand for it. Each new breakthrough in precision and detail creates possibilities for new breakthroughs in commercial products and applications.
We will elaborate on the consequences of using position data, later in this chapter when we look at the concept of *augmented reality*.

5. Stored

We already store incredible amounts of information, and the volume will grow exponentially as the trend towards microscopic detail and constant collection of data unfolds.

Each day billions of photos and millions of hours of video are recorded, the media sends out an avalanche of stories and broadcasts, mountains of data is generated by industry research, pharmaceutical and chemical screenings, astronomical observations, data from major research centers such as CERT. Then there are the files from all sorts of administrative tasks; a whole planets’ accounting and everyone’s e-mails. Google retains data on all searches for 180 days; telephone companies are obliged by law to store data about all our calls, all our text messages and our use of the network for at least a year. On top of that, there are the recordings from all the surveillance cameras, log files from our machines, data from stores and banks ...
The long term trend is that *everything* will be recorded and stored. Partly, because all aspects of our lives now interact with some form of digital technology. Partly, because increasingly it is cheaper to save data than having to search through the

material and delete the unneeded parts.

Life Recording: This is my life
A number of researchers and companies - including Nokia and Microsoft – are examining the consequences of recording *everything* you do. There are researchers who constantly walk around with a camera mounted on their head, which at short intervals take pictures or which records video constantly. In addition, they will record all their phone calls, their web-surfing, where they are, the movies and television programs they watch, the music they listen to ... It is called *Life Recording.*
Initially, it may be useful as a way to take notes of ones life. Should there be something you would like to revisit and take a closer look at, or if there is something you've forgotten, you can simply rewind your life stream recording. At a professional level, it might very well be required some day that, for example, policemen, doctors or others with great responsibility use a life-recorder to constantly document the circumstances surrounding the decisions they make.
Gordon Bell and Jim Gemmel, researchers at Microsoft's MyLifeBits project, in their book, *Total Recall*, describe a future scenario of using an intelligent smart computer system to analyze the lifestream data in order to offer some advice to the user. It could be to remind the user of important tasks or of meetings which he has forgotten, but it could eventually be more general or personal advice. The system will know its user in every detail, and in a networked context it could draw on analysis of a very large number of other people's lives. Therefore, the system could coach on the small and big decisions of everyday life - whether in health, career, education or economic matters.

6. Searchable: Anything can be Googled
When the Internet was only just beginning to grow, one of the concerns was that it would become exceedingly difficult to actually find what you needed, because the amount of information on the net was exploding, and all sorts of data was uploaded and added without any well defined organizing principle.
Google and other search engines effectively put that worry to shame. It's amazingly easy to find exactly what you're looking for. It's like a fairy tale, you just say the word, and you get what you want.

Data will be searched, filtered, indexed and analyzed with increasing precision - whether it's text, photos, credit card numbers, DNA sequences or RFID identification data from any object that is equipped with a chip.
The key will be the ability to articulate ones' wish with sufficient precision.

Computers are getting better and better at understanding what information means. An example: The technology of face recognition will mean that search engines can index photos, much as they currently index texts on websites. Once a search engine knows who a person in a photo is, it can try to match that individual's characteristics with those found on other photos. The system could in principle look through all photos on all websites and try to recognize who the characters in the picture are. Then you could search for all photos online showing a particular person – or object.
Once the contents of a photo, video or audio file is identified in *one* place, an intelligent system could automatically search the web and find plenty of other instances of the same content.

We have just discussed how all items may be equipped with a small RFID chip as a replacement for the current bar code. One consequence is that all the tagged objects become searchable. If an object with an RFID chip is within range of an RFID reader, which is connected to the Internet, one could in principle send out a query on the net based on the items' ID number and get to know where it is located.
At a small scale, one could imagine that you have forgotten your glasses somewhere, and therefore you send a query to know if there is a tag reader somewhere that receives a signal from the chip in your glasses.

Search goes way beyond slavishly reviewing databases to find instances that match what you seek. The quality of search is based on extensive and advanced analytical tools, and search engines have a growing knowledge that enables them to understand what kind of data they examine.
Tim Berners Lee, who invented the protocol underlying the World Wide Web, is now the head of an ambitious attempt to provide data with an extra layer of labels that will make a computer able to immediately see whether a particular information is a name, an address, a phone number, etc. The project is called the "semantic web". Perhaps it won't be the particular system that Tim Berners Lee's consortium is creating, which becomes the global standard for labeling information- there are other efforts pushing in the same direction - but the ambitions of the semantic web project gives an indication of the kinds of solutions that will help search engines become much better at understanding the data they are sifting through.

What's known as *audio and video fingerprinting* is an example of just how sophisticated search engines already are today. Video fingerprinting is used by Google to patrol their video service YouTube for clips that are uploaded without permission from the copyright owner. The way the technique works is that a record company will send Google a copy of a new music video, which they want to protect. Google analyzes the video and music and creates a "fingerprint"; a profile that describes the video in a way that makes the search engine able to recognize the video if it encounters it somewhere among the myriad of more or less official content on YouTube. If it encounters a clip that matches the video fingerprint, it flags an alert, and then it is up to the record company to decide if they will intervene to have the presumptuous clip removed.
The term *data mining* is often used to describe how massive amounts of data are analyzed to find specific patterns. You can mine for patterns in consumers' shopping habits, to intercept suspicious behaviors that might indicate criminal or terrorist activities or to find molecules or DNA sequences with specific functions.

7. The physical and the virtual realms merge

Objects will typically have both a physical and a virtual appearance, and it will be increasingly meaningless to think of these two sides as separate. Right from its "conception", an object and its associated data will be fully integrated.

Let's use a refrigerator as an example. A new model starts its life on the designer's and engineers' computer screens, probably assisted by a number of tools and technical data for simulations and cost calculations to optimize the product. When the design is done, the CAD drawings are sent to the factory to be transformed into a "real"

physical refrigerator.
As the fridge is produced, transported, marketed and sold, a great deal of data about what happens to it will be collected. In addition, a lot of other data is generated about the fridge: advertising campaigns, technical data, manuals, statutory warnings, and instructions for the robot that eventually will dismantle the cabinet and recyclable the materials.
The collecting of data continues when the customer starts to use the refrigerator at home. Sensors detect all the goods that are put in and taken out of the fridge; there will be a continuous log of temperatures and power consumption, reports of errors, updates, repairs - it's all recorded. Consequently you could say that, right from the first lines of the design, a kind of *virtual doppelgänger* is built up: a digital mirror image of the refrigerator.

A refrigerator, which is online with all its data, will be in a completely different class than a fridge that is offline. Both cabinets can keep beers cold - but that was the level of functionality we reached already in the fifties. It takes more than that to make a difference in the marketplace of the future.
The 21st Century refrigerator will - besides being extremely energy efficient - be an integral part of a number of networks: It will be in close interaction with the user's purchases and choices about diet, health and gastronomy.
In principle, the fridge will become a new point of sale, because, based on the foods that tend to be stored in the fridge, the customer can be presented with promotional offers on the screen built into the cabinet door, and the goods can be ordered directly by clicking on the screen. The fridge will be in contact with a service provider that continuously monitors whether it is functioning optimally. Like the freezer and water heater, the refrigerator's energy consumption can be adjusted depending on the price of electricity: When the wind turbines are spinning and power is cheap, the appliance can lower the temperature a few degrees extra to build up cold so it can idle when prices rise later in the day.
The point is that a very large part of the refrigerator’s functions and the service and business around the fridge become possible because the refrigerator has both a physical and a virtual aspect.

<u>Our physical and our virtual I become inseparable</u>

We humans will have a virtual doppelganger, too. From our conception and onwards, we generate a stream of data that will be collected throughout our life in ever-finer detail. Our virtual appearance will be like an aura around us, a layer of information outside of our physical appearance that can be seen if you have the right gear and the right access privileges.
Likewise, the world that we experience will be a mixture of physical and virtual elements, and it will make less and less sense to try to separate the two kinds of reality.

A very simple example: Where are you really when you are talking on the phone? When you play a game with others over the Internet? When you place an order online, triggering a product to be manufactured on the assembly line in another country?
We are present in several places at once - our attention and our actions are not only where our physical body is located.

Sometimes the many parallel realities conflict with each other. At 4 o'clock in the afternoon of September 12th 2008 a passenger train plowed into a freight train near Los Angeles, resulting in 25 dead and 135 wounded passengers. Before the collision, the train driver, who was killed in the disaster, had ignored three full stop traffic lights. It turned out later that the driver had sent a series of text messages in the minutes before the accident – and, probably, this was the reason that he had missed the signals.
The accident is a dramatic example of what the American sociologist Linda Stone has dubbed "continuous partial attention". The train driver was several places at once. Physically, of course, in the cockpit, but mentally he was more involved in a dialogue somewhere else.
This is not uncommon: A survey conducted by YouGov for the Danish insurance company Codan in 2010 showed that 47 percent of Danish motorists during the past year had written or read text messages while driving a car.

You can experience another extreme, but less dramatic example of this kind of divided attention, by taking the subway train in the South Korean capital of Seoul. All the passengers seem to be elsewhere, lost in interaction with their advanced mobile phone or engulfed in news, cartoons and commercials on the monitors hanging in the train. It is difficult to say, whether they have become more connected or more isolated because of the technology.
The sense that we and those we interact with are present in multiple universes simultaneously will undoubtedly spread. Any, even moderate, user of social services or online gaming universes knows the feeling of being torn between the real world and all the conversations, projects and relations that you are busy taking care of online.

Eventually, the many worlds will collude into one coherent experience, because the signals and the impressions overlap completely. GPS positioning technology could emerge as the bridge builder between the virtual and physical realms. Google Earth is the leading example of how information can be structured according to geographical location rather than alphabetically or chronologically. After zooming in on a specific location on the map, you can choose to turn on a multitude of additional layers of information that relate exactly to the place you are looking at. The layers can be comments, they can contain photos, links to video that was recorded at the location, or they can be computer graphics that are updated regularly, so you can see for example, how traffic flows, or what the weather is like there now. Currently, most people use Google Earth via the screen on a PC, but if you have a smart phone – and if you haven't, you will very soon - you can see the information, while you are at the position that the data is linked to. This turns the information into a layer of data on top of the physical reality we live in.

<u>The magical monocle - augmented reality</u>
The device we use to see the world through becomes a kind of *magical monocle*, a lens that lets you see both the physical reality and the data associated with it. In the early versions, it will be our mobile phone that we use. The image that the camera captures is displayed on the screen, with an added a layer of digital information about what the camera is pointing at.
Later, it will probably be a feature that is built into a pair of ordinary eyeglasses or contact lenses, so the virtual impression is not on a separate screen. Over half the

population wears glasses, so most people are already accustomed to walking around with a lens in front of their eyes.
It is called augmented reality – an "enriched reality."

It is not hard to think of possible uses. In a museum you could see not only the sculpture, which you are facing, but also a digital layer on top of it, of information with explanations about the artist. In traffic, you could have help finding routes and knowledge of shops and nearby attractions. Generally, much of the information we see today on a display could appear directly in our field of vision. Without a monitor, one could radically reduce the size and change the way we operate many of our gizmos: the phone, our laptop, and the various machines and appliances in the home and workplace.

Ideally, what you experience could be a complete fusion of digital graphics and video with the physical reality, but in order for that to be convincing, it would require that the "monocle" - whether it's a pair of glasses or a mobile phone – were exactly aware of where it is and which way it's facing. To the extent we succeed in developing this type of technology, one could imagine a meeting room where some of the seats were empty in the physical world, but through the monocle one would see people sitting there, participating via video link.
Spook Country, a novel by American sci-fi writer William Gibson, tells of a group of artists who create installations and performances that can only be viewed when the viewer is at a certain place. One of the artists' works is a reconstruction of a murder, and the audience sees the corpse as a digital layer that appears precisely where the body once lay in reality. It's all mixed: Past and present, here and there, real and fictional in the same experience. It is as if there are *ghosts* associated to a place: pictures and information about events that once took place and now become visible through the magic eyeglasses, depending on which layers of information you choose to turn on.

<u>The Metaverse is near</u>
The entire force of the digital world will be available and mixed inseparably with the analog experience of the world. The total fusion of the realms is still science fiction, but it is turning into reality at an accelerating speed.
Many of the elements of Steven Spielberg's *Minority Report* from 2002, have been realized since its bold predictions were first shown. When the hero of that movie controls the computer system, he is not using a keyboard and mouse, but making gestures in the air - much like the way millions of people now control their gaming consoles. We are increasingly interacting with the virtual world by pointing, shaking, bouncing and jumping, and the machines understand our gestures and recognize our faces – just like when we deal with people and animals in the physical reality.

In Minority Report, you also see an excellent enactment of how all the advertising and information displays in a city are experienced differently by each person. It would be a logical consequence, the day we all bear augmented reality glasses, that we no longer see the same city. The physical environment we move through, is only part of what we are experiencing. What we see and those we see will depend on what digital layers we have turned on.
Today, millions of people spend unimaginable amounts of time building huge and fantastic virtual worlds and communities in graphical online universes like World of

Warcraft and Everquest. It's only a matter of time before it becomes possible to create mashups that will merge the data of graphical fantasy worlds and the "real" geographically positioned data in services like Google Earth.
There is already a name for this totally converged universe, which emerges when the virtual and physical world fuse: *The Metaverse.*
That’s where we will live in future.

<u>The digital force changes the game rules</u>
We've been through seven trends that will shape our use of information in the future: Information will be increasingly detailed, it will be updated in realtime, connected in a global network, geographically positioned, stored, searchable, and the experience of data will be completely integrated into our physical reality.
Together they form the "digital force" that any object that is equipped with a chip and a connection to the network will be equipped with.

Whatever industry you belong to, you can, with a little imagination, use the seven trends of information as an indication of what will be possible in utilizing information in relation to the products you produce: What happens when your business is flooded by the tsunami of information? Will your company benefit from this development if you follow the strategy you have laid out for the coming year? Are your products *on* or not? Are the products, that you are just now starting to develop, stand alone devices or will they be able to connect?
In case you don’t have an eye for what the trend means, you can be assured that there will be others who will manage to make a difference in the market by leveraging the rapidly growing availability of detailed, realtime, and related information.